US005236139A

United States Patent [19]

Radtke

[11] **Patent Number: 5,236,139**

[45] **Date of Patent: Aug. 17, 1993**

[54] **WEAR ADJUSTABLE SHREDDER**

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[73] Assignee: **Ameri-Shred Industrial Corp.**, Alpena, Mich.

[21] Appl. No.: **926,515**

[22] Filed: **Aug. 10, 1992**

[51] **Int. Cl.**[5] **B02C 18/18**

[52] **U.S. Cl.** **241/236**; 241/286; 241/295

[58] **Field of Search** 241/236, 286, 295; 83/502

[56] **References Cited**

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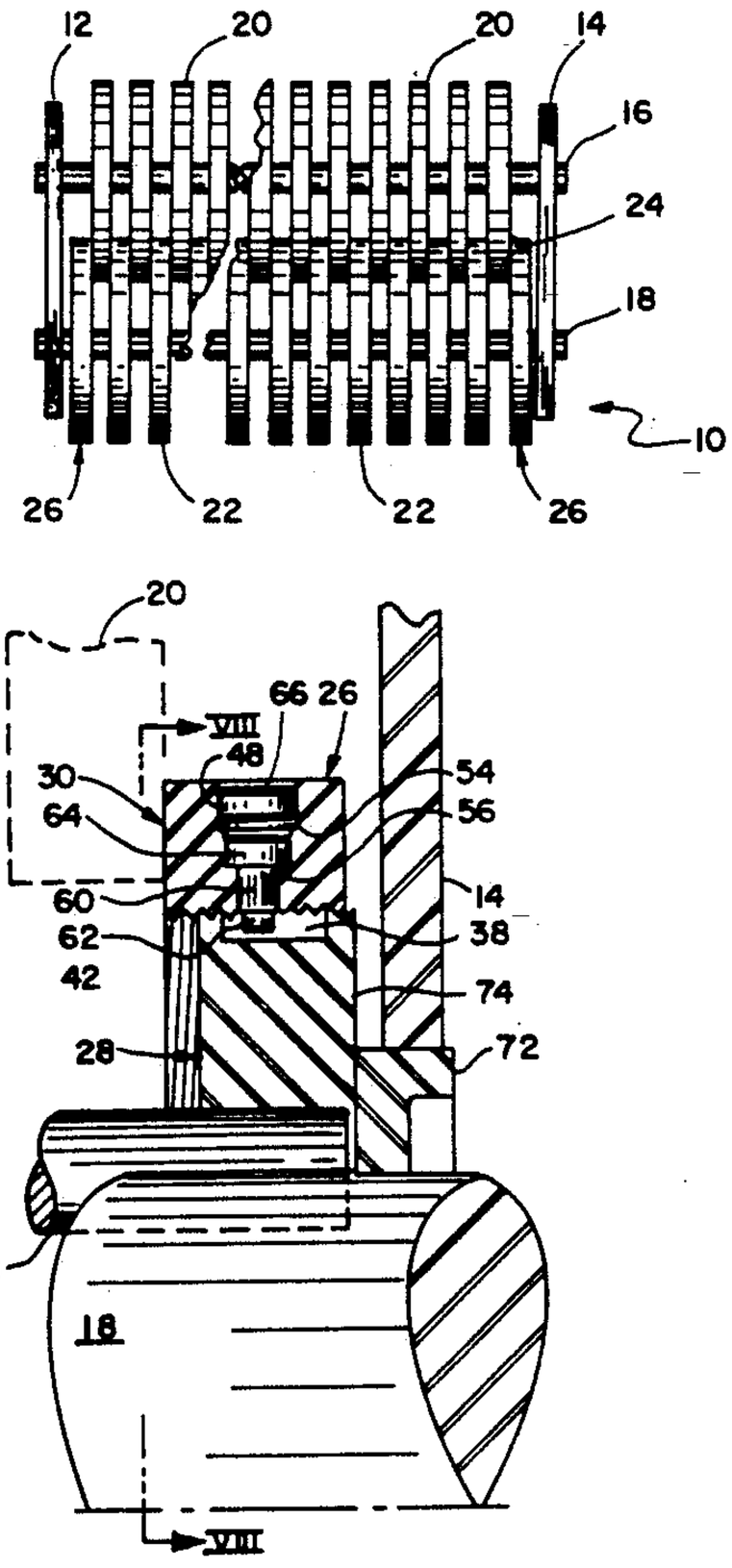
Primary Examiner—Mark Rosenbaum
Assistant Examiner—John M. Husar
Attorney, Agent, or Firm—Warner, Norcross & Judd

[57] **ABSTRACT**

A wear adjustable shredder having spaced apart, parallel rotating shafts, series of interleaved and overlapping cutter disks carried on the shafts, and an adjustable cutter disk assembly carried endmost on one of the shafts, the adjustable cutter disk assembly having an inner adjusting ring and an outer cutting ring with the cutting ring threaded on the adjusting ring. The cutting ring may be rotated with respect to the adjusting ring such that the ring moves axially toward or away from the cutter disks to adjust the spacing of the cutter disks.

23 Claims, 3 Drawing Sheets



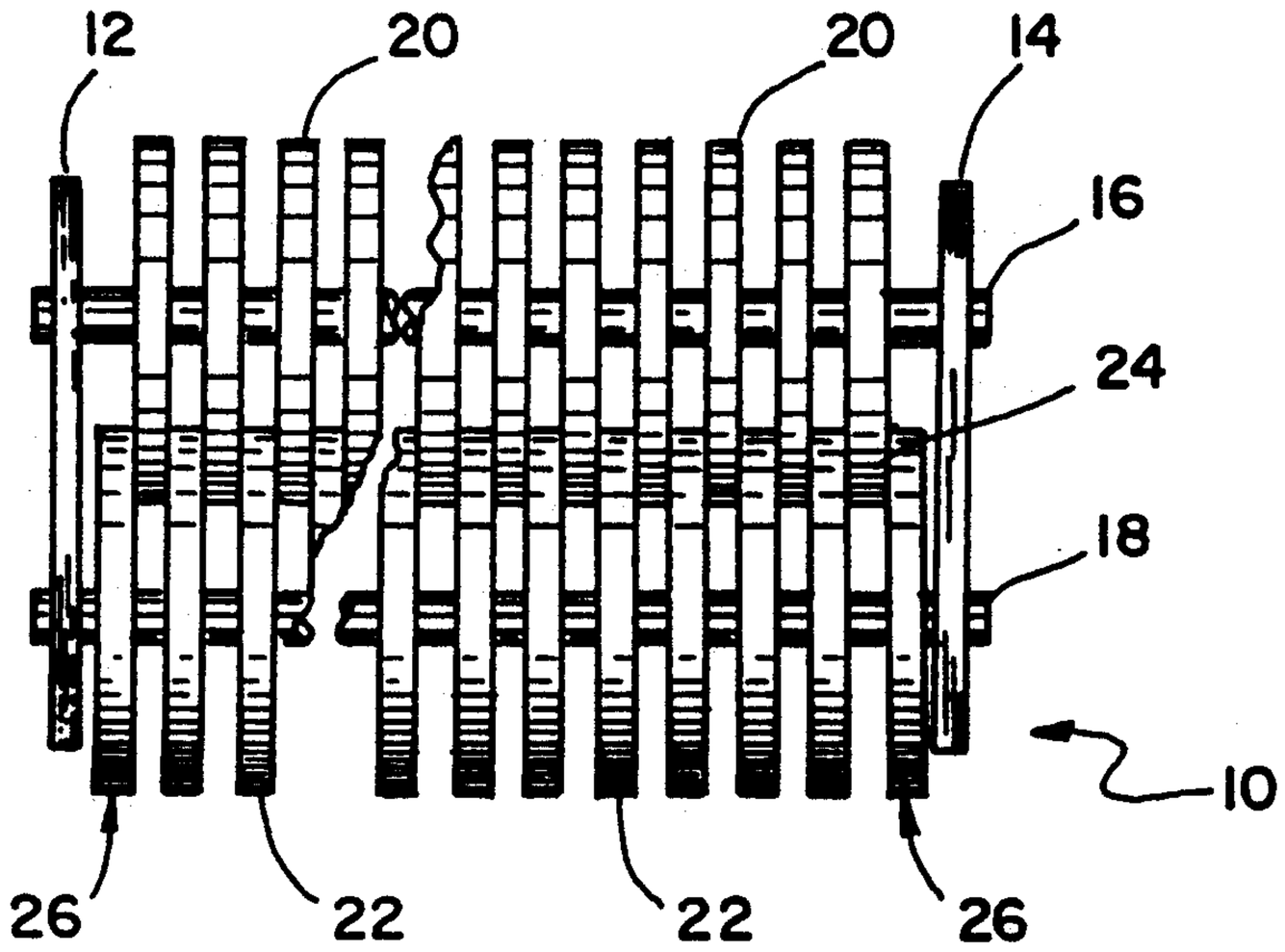


FIG. 1

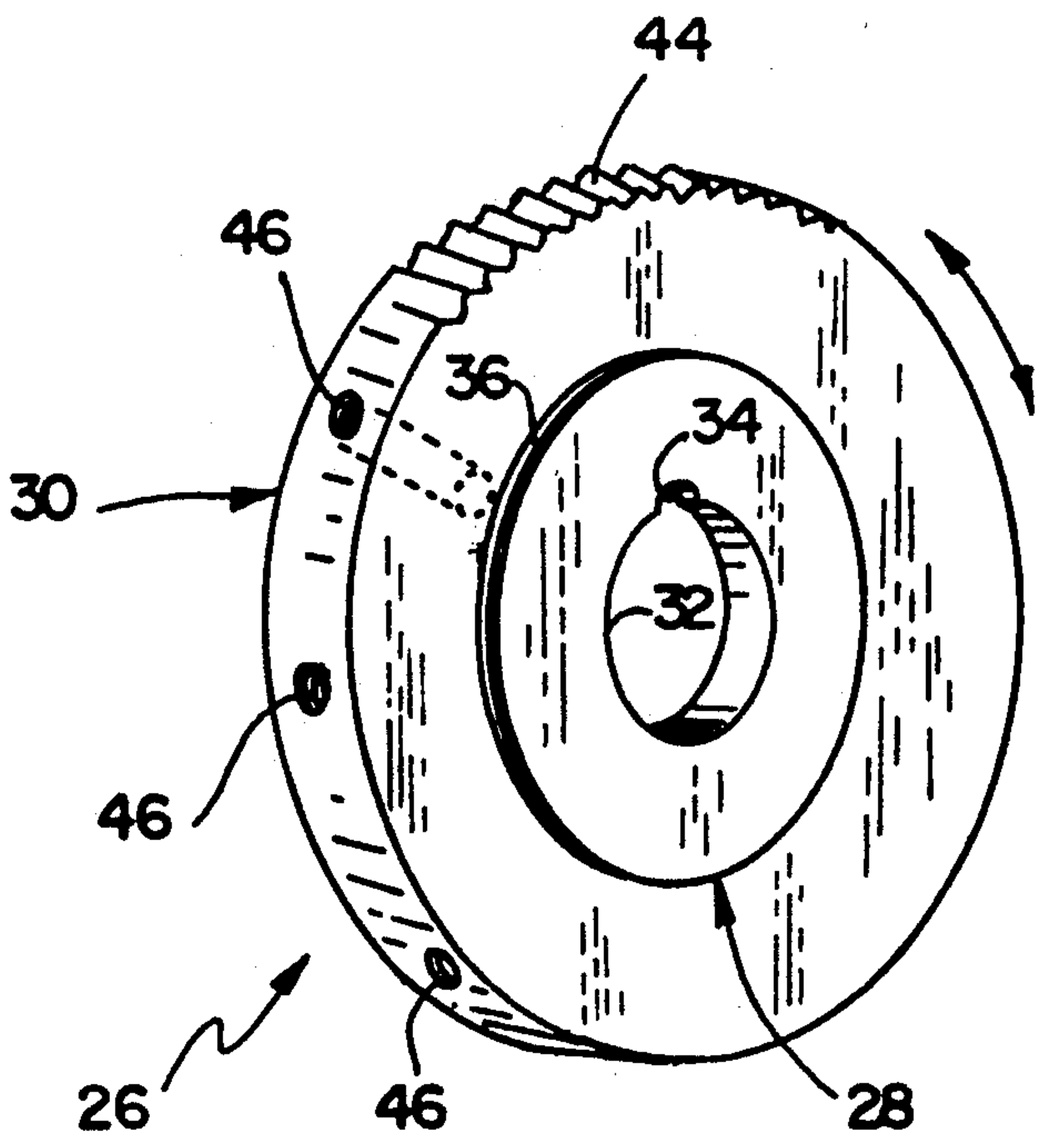


FIG. 2

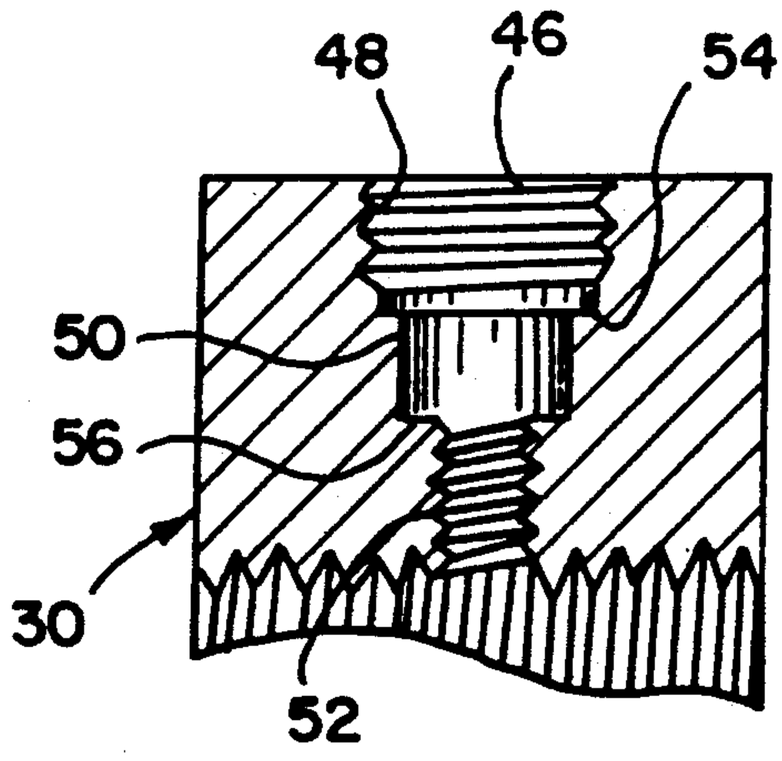


FIG. 9

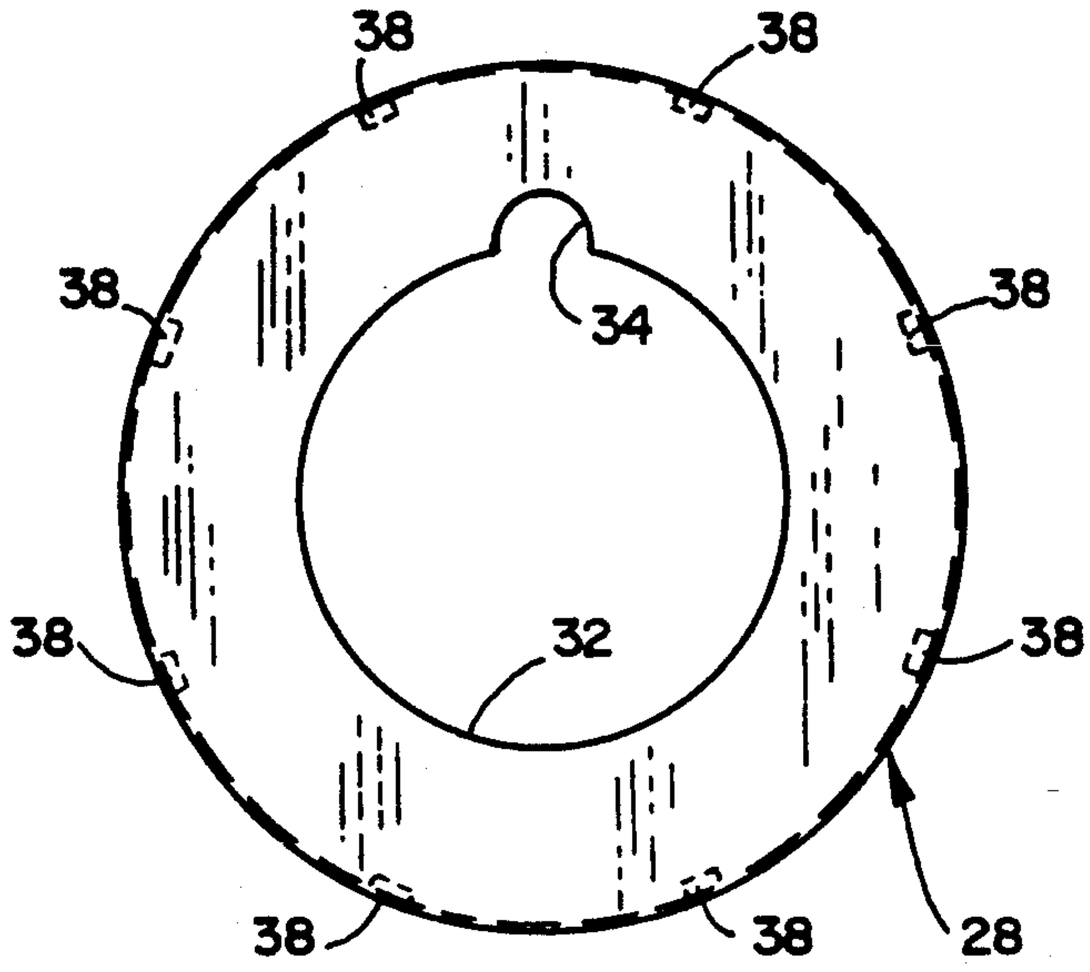


FIG. 3

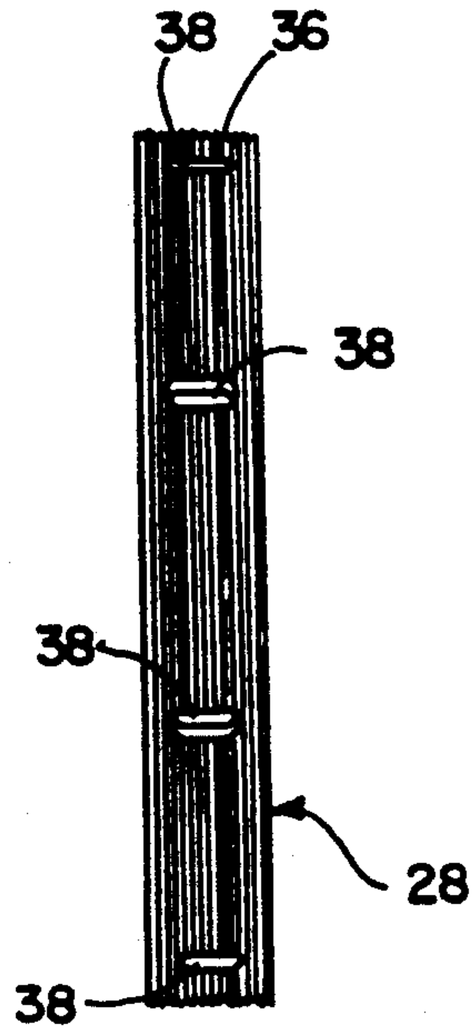


FIG. 4

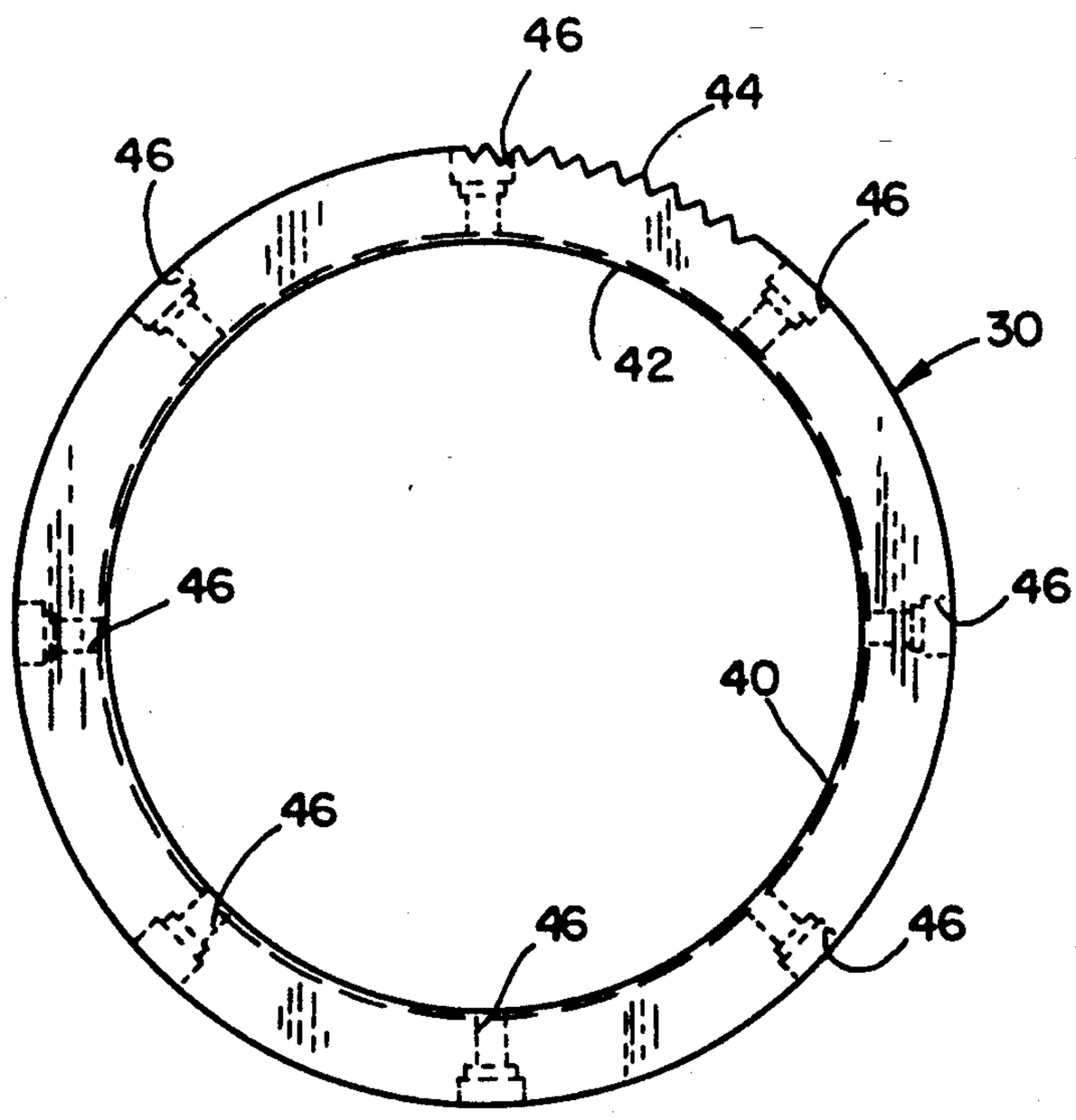


FIG. 5

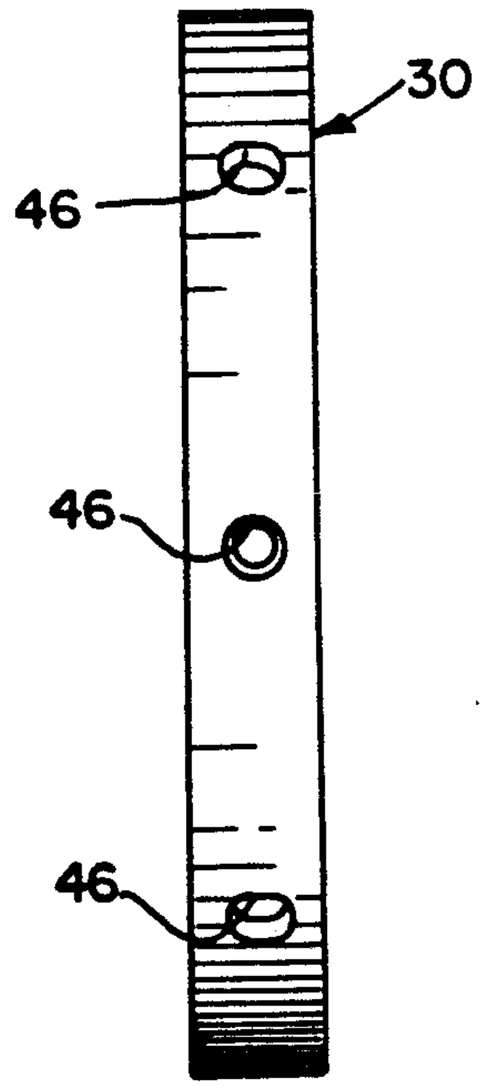


FIG. 6

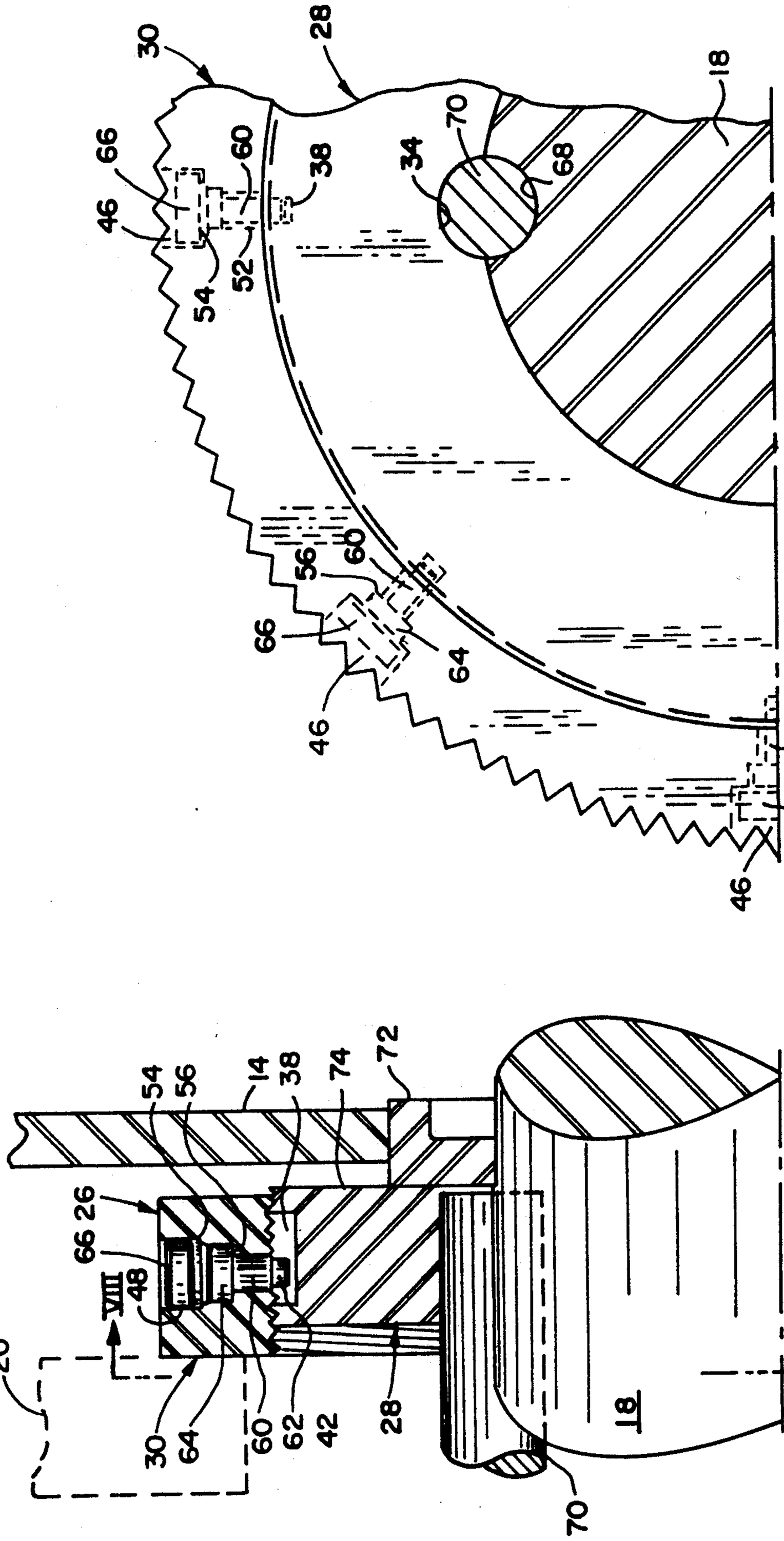

30
28
18
70
66
60
38
34
68
46
52
54
56
64
62
42

FIG. 8

54
56
14
38
74
72
66
26
48
VIII
20
30
64
60
62
42
28
18
70

FIG. 7

WEAR ADJUSTABLE SHREDDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to shredders and, more particularly, to a shredder having wear adjustable cutter disks.

2. Description of the Related Art

Shredders are known in which two series of interleaved cutter or slitter disks are each mounted on parallel, spaced apart, counter-rotating shafts. The circumferences of the disks on one shaft are overlapped with the disks on the other shaft such that material fed into the nip formed at the overlap of the disks is shredded.

It is necessary for the proper functioning of such shredders that the cutter disks carried on the shafts be very closely spaced, or even in contact, with each other at the overlaps therebetween. The disks therefore rub against each other, and against the material being shredded, resulting in wear which reduces the thickness of the disks over time. As the disks become thinner, it is necessary to compensate by providing some means for again bringing the disks close together on the shafts.

In the past, the cutter disks have been axially slidable on the shafts, and bronze wear plates have been wedged against the endmost cutter disks to urge the disks closely together. However, such wear plates wear rapidly and require frequent replacement. Furthermore, the wear plates impart a considerable amount of heat to the assembly through friction, thereby affecting the hardness of the cutter disks.

It is desirable for the wear adjustment device to be mechanically simple, durable, economically constructed, unobtrusive, retrofittable to existing equipment, and easily adjusted.

SUMMARY OF THE INVENTION

The present invention provides a wear adjustable shredder in which one or both of the endmost cutter disks is a concentric assembly of an inner adjusting ring threaded on its outer circumference and an outer cutting ring threaded on its inner circumference. The threads of the adjusting ring mate with the threads of the cutting ring. The axial position of the cutting ring is adjusted by rotating the cutting ring relative to the adjusting ring. By so rotating the cutting ring, the cutting disks are brought more closely together to compensate for the reduction in thickness caused by the cutting disks rubbing together.

According to the invention, the outer circumference of the adjusting ring is formed with several circumferentially spaced apart, axially elongated slots or recesses. The cutting ring is formed with several radial tapped and counterbored holes in correspondence with the recesses of the adjusting ring. Screws are inserted into the holes of the cutting ring such that the screws engage the recesses of the adjusting ring, thereby preventing rotation of the cutting ring relative to the adjusting ring. To make a wear adjustment, the screws are loosened, the cutting ring is turned on the adjusting ring, and the screws are retightened.

The structure of the inner portion of the adjusting ring is similar to the inner portion of a standard cutter disk. The structure of the outer portion of the cutting ring is similar to the outer portion of a standard cutter disk. Therefore, the adjustable cutter disk assembly of the invention is readily and economically retrofittable to existing shredding equipment.

Since the adjustable cutter disk assemblies are functioning cutter disks, the full width of the shredder is available for shredding action. The elimination of bronze wear plates also eliminates the heat generation problems of such wear plates.

These and other objects, advantages, and features of the present invention will be more fully understood and appreciated by reference to the written specification and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevational view of a wear adjustable shredder according to the principles of the invention;

FIG. **2** is a perspective view of an adjustable cutter disk assembly; and

FIG. **3** is a side view of the adjusting ring;

FIG. **4** is a front view of the adjusting ring;

FIG. **5** is a side view of the cutting ring;

FIG. **6** is a front view of the cutting ring;

FIG. **7** is a fragmentary, front view, with parts in vertical section, of an adjustable cutter disk assembly mounted on the end of a shaft;

FIG. **8** is a side view of the cutter disk assembly and shaft taken substantially along the line **8**—**8** of FIG. **7**; and

FIG. **9** is a fragmentary, sectional view of the cutting ring showing details of the cutting ring holes.

DESCRIPTION OF THE PREFERRED EMBODIMENT

By way of disclosing a preferred embodiment, and not by way of limitation, there is shown in FIG. **1** a wear adjustable shredder **10** which includes in its general organization a supporting structure having a pair of spaced-apart end plates **12**, **14**, a first, or upper, rotating shaft **16** and a parallel second, or lower, rotating shaft **18** both extending between the end plates, a plurality of upper cutter disks **20**, and a plurality of lower cutter disks **22**. The shafts are spaced apart by a distance less than the diameter of the cutter disks. The shafts **16** and **18** pass through center holes in each of the cutter disks **20**, **22** such that the cutter disks are carried on the shafts and are able to slide axially on the shafts without canting. The cutter disks are keyed to the shafts. The spacing of the shafts and the diameter of the cutter disks are such that the cutter disks are interleaved and overlapped to form a nip **24**. A motor and suitable drive mechanism (not shown) are provided to forcibly counter-rotate the cutter disks such that material fed into the nip is shredded or cut.

The spacing of the shafts and the diameter of the cutter disks are such that the cutter disks are interleaved and overlapped to form a nip **24**. In order for the shredder to operate properly, the cutter disks must be in contact with each other or very closely spaced. As a result, the overlapping outer annular portions of the flat surfaces of the cutter disks rub together. This rubbing causes the cutter disks to become thinner. It is then necessary to again bring the cutter disks close together to compensate for the wear. It is this adjustment with which the present invention is concerned.

The endmost cutter disks carried on the lower shaft **18** are adjustable cutter disk assemblies **26**. With this arrangement, both cutter disk assemblies **26** may be adjusted to keep the cutter disk assemblies centered between the end plates or on the shaft. The use of two

cutter disk assemblies also provides a greater range of adjustment. However, it is optional and within the scope of the invention to use only a single cutter disk assembly **26** outermost at only one end of a shaft. Also, the cutter disk assembly may be placed on the top shaft, or on either one of side by side shafts in a top feed arrangement.

As shown in FIG. **2** each adjustable cutter disk assembly **26** includes an inner adjusting ring **28** and an outer cutting ring **30** encircling and concentric with the adjusting ring **28** and with the shaft on which the adjusting ring is carried.

Referring also to FIGS. **3** and **4**, the adjusting ring **28** is formed with a center hole **32** having a diameter slightly larger than the diameter of the shaft **18** on which the adjusting ring is carried such that the adjusting ring can slide axially on the shaft without canting. A semicircular recess **34** is formed in the inner circumference of the adjusting ring to mate with a cylindrical key rod as discussed more fully below.

The outer circumferential surface of the adjusting disk **32** is formed with helical threads **36**. The outer circumferential surface of the adjusting disk is further formed with eight evenly spaced recesses **38**. More or fewer recesses may be employed. Each recess **38** is axially elongated, extending across most of the width of the circumferential surface of the adjusting disk.

Referring to FIGS. **2**, **5**, and **6**, cutting ring **30** has an inner diameter substantially equal to the outer diameter of adjusting disk **32**. The inner circumferential surface **38** of the cutting ring is formed with helical threads **42** (see also FIG. **7**) which mate with the threads **36** of the adjusting disk **28**. The outer circumferential surface of the cutting ring **30** is formed with teeth **44**. Alternatively, the outer circumferential surface **30** may be left smooth if, for example, the shredder is to be used for slitting.

Cutting ring **30** is formed with eight evenly spaced, radially extending holes **46**. Thus, cutting ring holes **46** coincide with the recesses **38** of the adjusting ring **28**. Details of the cutting ring holes **46** are shown in FIG. **9**. Each hole **46** includes a tapped outer portion **48**, an untapped intermediate portion **50** having a diameter smaller that the diameter of the outer portion **48**, and a tapped inner portion **52** having a diameter smaller than the diameter of the intermediate portion **50**. An outer shoulder **54** is formed between outer portion **48** and intermediate portion **50**. An inner shoulder **56** is formed between intermediate portion **50** and inner portion **52**.

As shown in FIGS. **7** and **8**, socket head cap screws **60** are threaded into the inner portion **52** of each hole **46** of the cutting ring. In order to lock the cutting ring so that it does not rotate relative to the adjusting ring, the tip **62** of each socket head cap screw **60** protrudes through the cutting ring **30** into one of the slots **38** of the adjusting ring **28**. Socket head cap screw **60** is tightened such that the underside of the cap **64** of each socket head cap screw is tight against the inner shoulder **56** to limit the distance by which the tip **62** protrudes.

A plug in the form of disk-like socket set screw **66** is threaded into the outer portion **48** of each cutting disk hole. Each socket set screw **66** is tightened such that the underside of the socket set screw is tight against the outer shoulder **54** of the hole **46**. The socket set screws **66** capture the socket head cap screws **60** within the holes **46** and prevent unwanted withdrawal of the socket head cap screws.

The lower shaft **18** on which the adjustable cutter disk assemblies **26** are carried is formed with an axial semi-cylindrical recess **68**. The recess **34** of the adjusting disk is aligned with the recess **68** of the shaft **18** and a cylindrical key rod **70** passes through the opening thus formed. Key rod **70** locks the cutter disk assembly **26**, as well as the other cutter disks on the shaft, to the shaft **18** such that the cutter disk assembly is drivingly rotated by the shaft **18**. The key rod **70** may have other shapes, such as square or rectangular.

As shown in FIG. **7**, bearing spacer **72** is fixed directly or indirectly to the end plate **14**. Bearing spacer **72** and end plate cooperatively retain the cutter disk assembly **26** on the shaft **18**. Bearing spacer **72** contacts the adjacent surface **74** of the adjusting ring **28** and provides an axial reaction force urging the adjusting ring toward the opposite end plate.

To adjust the spacing of the shredder disks, all of the socket head set screws **66** are removed from the holes **46** of the cutting ring **30**. Next, all of the socket head cap screws **60** are loosened until their tips **62** are disengaged from the slotted recesses **60** of the adjusting ring **28**. Then, with the shaft **18** and adjusting ring **28** held stationary, the cutting ring **30** is rotated, thus causing the cutting ring to move axially toward or away from the cutting disks **20**, **22** on the shafts. When the desired adjustment has been obtained, the cutting ring is further rotated to bring each hole **46** into alignment with the nearest recess **38**. The socket head cap screws **60** are tightened to engage the recesses **38** and lock the axial adjustment of the cutter disk assembly **26**. Finally, the socket head set screws **66** are replaced. If two cutter disk assemblies **26** are used, as in FIG. **1**, each assembly may be adjusted to keep the series of cutter disks centered on the shafts.

It has been found that SAE 4150 is a suitable material for the adjusting ring, and that A2 hardened tool steel is suitable for the cutting ring.

With an adjusting ring having a nominal outer diameter of ten inches, the threads on the outer circumferential surface of the adjusting ring are suitably formed at ten threads per inch. With these specifications, one-eighth of a rotation of the cutting ring with respect to the adjusting ring yields an axial adjustment of 0.012 inch. The assembly may then be used to allow a desirable disk spacing with no more than 0.015 inch between any two cutter disks.

The above description is that of a preferred embodiment of the invention. Various alterations and changes can be made without departing from the spirit and broader aspects of the invention as set forth in the appended claims, which are to be interpreted in accordance with the principles of patent law, including the Doctrine of Equivalents.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a shredder of the type having spaced apart, rotating shafts, each of the shafts carrying a series of axially freely slidably cutting disks with the cutting disks of one shaft interleaved and overlapped with the cutting disks of the other shaft, the combination therewith of a cutter disk assembly comprising:

an adjusting ring carried endmost on an axially extending portion of one of the shafts and having a threaded outer circumferential surface, said series of axially freely slidable cutting disks carried on

said one of the shafts disposed axially spaced apart from said adjustment ring;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the threaded outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring.

2. An adjustable cutter disk for a shredder comprising:

an adjusting ring having a central hole for the passage of a rotating shaft and a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring,

said adjusting ring adapted to be carried on an axially extending portion of the rotating shaft and having an axial thickness substantially the same as the thickness of said cutting ring;

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring.

3. The adjustable cutter disk of claim 2 further comprising means formed in said central hole of said adjusting disk for keying said adjusting disk for corotation with a rotating shift.

4. A wear adjustable shredder comprising:

first and second rotating shafts;

a supporting structure supporting said first and second shafts in parallel, spaced apart relationship;

a first series of cutting disks carried on said first shaft and axially slidable thereon;

a second series of cutting disks carried on said second shaft and axially freely slidable thereon, said second series of cutting disks being interleaved and overlapping with said first series of cutting disks; and

at least one cutting disk assembly carried endmost on said second shaft and comprising:

an adjusting ring encircling an axially extending portion of said second shaft and disposed axially spaced apart from said second series of cutting disks, said adjusting ring having a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring;

whereby rotation of said cutting ring with respect to said adjusting ring causes said cutting ring to move axially toward or away from said second series of cutting disks.

5. The wear adjustable shredder of claim 4 further comprising a second said cutting disk assembly carried endmost on said second shaft opposite said at least one cutting disk assembly.

6. The wear adjustable shredder of claim 4 further comprising means for urging said cutting disk assembly axially toward said second series of cutting disks.

7. In a shredder of the type having spaced apart, rotating shafts, each of the shafts carrying a series of axially slidable cutting disks with the cutting disks of one shaft interleaved and overlapped with the cutting disks of the other shaft, the combination therewith of a cutter disk assembly comprising:

an adjusting ring carried endmost on one of the shafts and having a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the threaded outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, said means for selectably releasing comprising at least one radial hole formed through said cutting ring and a withdrawable fastener extending through said hole and engaging said outer circumferential surface of said adjusting ring.

8. The combination of claim 7 wherein said outer circumferential surface of said adjusting ring is formed with at least one recess, and wherein said fastener extends into said recess when said cutting ring is locked against rotation with respect to said adjusting ring.

9. The combination of claim 8 wherein said recess is axially elongated.

10. In a shredder of the type having spaced apart, rotating shafts, each of the shafts carrying a series of axially slidable cutting disks with the cutting disks of one shaft interleaved and overlapped with the cutting disks of the other shaft, the combination therewith of a cutter disk assembly comprising:

an adjusting ring carried endmost on one of the shafts and having a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the threaded outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, wherein said means for selectably releasing comprises a plurality of circumferentially spaced apart radial holes formed through said cutting ring, a plurality of circumferentially spaced apart recesses formed in said circumferential surface of said adjusting ring in correspondence with said holes, and a plurality of withdrawable fasteners, each of said fasteners extending through one of said holes and into one of said recesses thereby to lock said cutting ring against rotation with respect to said adjusting ring.

11. An adjustable cutter disk for a shredder comprising:

an adjusting ring having a central hole for the passage of a rotating shaft and a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring;

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, said means for selectably releasing and locking comprising at least one radial hole formed through said cutting ring and a withdrawable fastener extending through said hole and engaging said outer circumferential surface of said adjusting ring.

12. The adjustable cutter disk of claim **11** wherein said outer circumferential surface of said adjusting ring is formed with at least one recess, and wherein said fastener extends into said recess when said cutting ring is locked against rotation with respect to said adjusting ring.

13. The adjustable cutter disk of claim **12** wherein said recess is axially elongated.

14. An adjustable cutter disk for a shredder comprising:

an adjusting ring having a central hole for the passage of a rotating shaft and a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring;

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and thereby axial movement with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, said means for selectably releasing comprising a plurality of circumferentially spaced apart radial holes formed through said cutting ring, a plurality of circumferentially spaced apart recesses formed in said outer circumferential surface of said adjusting ring in correspondence with said holes, and a plurality of withdrawal fasteners, each of said fasteners extending through one of said holes and into one of said recesses thereby to lock said cutting ring against rotation with respect to said adjusting ring.

15. The adjustable cutter disk of claim **14** further comprising a plurality of plugs, each of said plugs received in one of said holes disposed radially outwardly of a said fastener to prevent unwanted withdrawal of said fastener.

16. The adjustable cutter disk of claim **14** further comprising means formed in said central hole of said adjusting disk for keying said adjusting disk for corotation with a rotating shaft.

17. A wear adjustable shredder comprising:

first and second rotating shafts;

a supporting structure supporting said first and second shafts in parallel, spaced apart relationship;

a first series of cutting disks carried on said first shaft and axially slidable thereon;

a second series of cutting disks carried on said second shaft and axially slidable thereon, said second series of cutting disks being interleaved and overlapping with said first series of cutting disks; and

at least one cutting disk assembly carried endmost on said second shaft and comprising:

an adjusting ring having a center hole for the passage of said second shaft and a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, said means for selectably releasing comprising at least one radial hole formed through said cutting ring and a withdrawable fastener extending through said hole and engaging said outer circumferential surface of said adjusting ring;

whereby rotation of said cutting ring with respect to said adjusting ring causes said cutting ring to move axially toward or away from said second series of cutting disks.

18. The wear adjustable shredder of claim **17** further comprising a second said cutting disk assembly carried endmost on said second shaft opposite said at least one cutting disk assembly.

19. The wear adjustable shredder of claim **17** further comprising means for urging said cutting disk assembly axially toward said second series of cutting disks.

20. The wear adjustable shredder of claim **17** wherein said outer circumferential surface of said adjusting ring is formed with at least one recess, and wherein said fastener extends into said recess when said cutting ring is locked against rotation with respect to said adjusting ring.

21. The wear adjustable shredder of claim **20** wherein said recess is axially elongated.

22. A wear adjustable shredder comprising:

first and second rotating shafts;

a supporting structure supporting said first and second shafts in parallel, spaced apart relationship;

a first series of cutting disks carried on said first shaft and axially slidable thereon;

a second series of cutting disks carried on said second shaft and axially slidable thereon, said second series of cutting disks being interleaved and overlapping with said first series of cutting disks; and

at least one cutting disk assembly carried endmost on said second shaft and comprising:

an adjusting ring having a center hole for the passage of said second shaft and a threaded outer circumferential surface;

a cutting ring encircling said adjusting ring and having a threaded inner circumferential surface engaging the outer circumferential surface of said adjusting ring; and

means for selectably releasing said cutting ring for rotation with respect to said adjusting ring and for locking said cutting ring against rotation with respect to said adjusting ring, said means for selectably releasing comprising a plurality of circumferentially spaced apart radial holes formed through said cutting ring, a plurality of circumferentially spaced apart, axially elongated recesses formed in said outer circumferential surface of said adjusting ring in correspondence with said holes, and a plurality of withdrawable fasteners, each of said fasteners extending through one of said holes and into one of said

recesses thereby to lock said cutting ring against rotation with respect to said adjusting ring;

whereby rotation of said cutting ring with respect to said adjusting ring causes said cutting ring to move axially toward or away from said second series of cutting disks.

23. The adjustable cutter disk of claim 22 further comprising a plurality of plugs, each of said plugs received in one of said holes disposed radially outwardly of a said fastener to prevent unwanted withdrawal of said fastener.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,236,139
DATED : August 17, 1993
INVENTOR(S) : John A. Radtke

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Column 4, claim 1, line 61:
"slidably" should be --slidable--

Column 5, claim 1, line 2:
"adjustment" should be --adjusting--

Column 5, claim 3, line 34:
"shift" should be --shaft--

Column 7, claim 14, line 43:
"withdrawal" should be --withdrawable--

Signed and Sealed this
Twelfth Day of April, 1994

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks